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2.1

Patterns and Reasoning

A) Inductive Reasoning

reasoning based on patterns you observe

B) Conjecture

educated guess

Make a conjecture:

1. $\angle A$ is complementary to $\angle B$ 2. $\angle A$ and $\angle B$ are a linear pair3. A, B, C then $AB = 10$, $BC = 8$ and $AC = 5$

C) Counterexample

An example that makes a conjecture false.

Ex: #1 The sum of two prime numbers is a prime number.
 #2 Given: P, Q, R are collinear
 conjecture: Q is between P and R
 #3 Given: A, B, C are collinear and B is between A & C
 Conj: B is the midpoint of AC

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B. Counterexample: shows that a conditional is false.

1. Only one counterexample is needed to show that a conditional is false.
2. Statements or pictures can be used as counterexamples.

Ex: Find a counterexample to show the conditional is false.

- 1) If $x^2 \geq 0$, then $x \geq 0$.
- 2) If you live in SC, then you live in Charleston.
- 3) If B is between A and C, then B is the midpoint of \overline{AC} .

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D) Deductive Reasoning

reasoning based on facts, definitions, and accepted properties in a logical order

Ex: Give an example of deductive reasoning

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2.2

I. Conditional Statements

A. Conditional: a statement written in "if - then" form.

1. Algebraically: $p \rightarrow q$ (p implies q)
2. Hypothesis (p): "if" part of a conditional
3. Conclusion (q): "then" part of a conditional
4. Every conditional has a truth value of true or false. *The only way a conditional can be false is if its hypothesis is true and its conclusion is false.

Ex: Write a conditional for each.

1) A rectangle has 4 right angles.

Conditional:

2) An acute angle measures less than 90° .

Conditional:

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- C. Converse: switches the hypothesis and conclusion of a given conditional.
1. Algebraically: $q \rightarrow p$ (q implies p)
 1. A converse can have a truth value of true or false. It does not have to be the same truth value as its conditional.

Ex: Write the converse of each conditional.

- 1) If two lines are parallel, then they are coplanar.

Converse:

- 2) If an animal is a cat, then it has 4 legs.

Converse:

- 3) If two lines do not intersect, then they are parallel.

Converse:

- 4) If $x = 2$, then $|x| = 2$

Converse:

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Bellwork:

Write each conditional statement in "if-then" form:

- 1) All triangles have three angles

- 2) Every Thursday Julia goes swimming

Write the converse inverse, and contrapositive of each conditional. Determine if the converse is true or false. If it is false, give a counterexample

- 3) If a figure is a rectangle, then it has four sides

Inverse- negate the hypothesis and the conclusion

$\sim p \rightarrow \sim q$

not $p \rightarrow$ not q

EX: Vertical angles are congruent.

Conditional-

converse-

inverse-

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Contrapositive- switch and negate the hypothesis and the conclusion
not $q \rightarrow$ not p

If angles are vertical, then they are congruent.

contrapositive-

Write the conditional, the converse, inverse and contrapositive

All right angles are congruent

If an animal can swim, then it is a fish.

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You will be more successful when you prepare for your goals.

What is the hypothesis?

What is the conclusion?

Write a conditional for the given statement.

Write the inverse.

Write the converse.

Write the contrapositive.

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2.3

II. Laws of Reasoning

A. Inductive reasoning: reasoning based on patterns you observe.

B. Deductive reasoning: reasoning using facts. The process of reasoning from given statements to conclusions.

C. Law of Detachment

If $p \rightarrow q$ is a true statement and p is true then q must be true.

Ex: Draw a conclusion from the given conditional and statement:

1) If it rains, then the yard will be watered.

It rained on Tuesday.

Conclusion:

2) If the car is red then it will get a ticket.

John got a ticket.

Conclusion:

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Law of Detachment

RECAP:

$$p \rightarrow q$$

p is true
conclusion: q

$$p \rightarrow q$$

q is true
conclusion: *none*

Hypothesis, conclusion
Repeat HYPOTHESIS

OR

$p \rightarrow q$
repeat p

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Use the Law of Detachment if possible.
give a conclusion if it is valid.

1. If a vehicle is a car, then it has 4 wheels.
A Saturn is a car.

Conclusion:

2. If two numbers are odd, then their sum is even.
3 and 5 are odd.

Conclusion:

3. If an animal is a dog, then it has 4 legs.
Spot has 4 legs.

Conclusion:

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4. If I watch TV, I will not do my homework.
I did not do my homework.

Conclusion:

5. If two angles are vertical, then they are congruent.
 $\angle A$ and $\angle B$ are congruent.

Conclusion:

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D. Law of Syllogism:

If $p \rightarrow q$ and $q \rightarrow r$ are both true statements,
then $p \rightarrow r$ is a true statement.

Ex: Write a conclusion from the given information:

1) If it rains, then Jane stays inside.

If Jane stays inside, she does not get wet.

Conclusion:

2) If Sam is a dog, then he has spots.

If Sam has a tail, then he has spots.

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Algebraically: $p \rightarrow q$ conditional
 $q \rightarrow p$ converse
 $p \leftrightarrow q$ bi-conditional

law of detachment

$p \rightarrow q$
 p is true
 q is true

law of syllogism

$p \rightarrow q$
 $q \rightarrow r$
 $p \rightarrow r$

use the Law of Syllogism if possible. Give a conclusion if valid.

1. If I do my homework, then I will get a 100.
 If I get a 100, my Mom will be happy.

Conclusion:

2. If I go to the movies, I'll want popcorn.
 If I want popcorn, I'll need money.

Conclusion:

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3. If 2 planes intersect, their intersection is a line.
 If 2 lines intersect, their intersection is a point.

Conclusion:

4. If I clean my room, I can go out tonight.
 If I go out tonight, I'll be happy.

Conclusion:

Name the rule or law and give a conclusion if possible:

1. If the sun shines today, the tomatoes will ripen. If the tomatoes ripen, we can have salad for dinner.

2. If an angle is 120 degrees, then it is obtuse. $m\angle C = 120$ degrees

3. If I live in Charleston, then I live in SC. Anna lives in SC.

4. If I study at least one hour a day, I can get better grades. If I get better grades, I can try out for the basketball team.

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5. If you are not satisfied with a DVD, you can return it for a full refund. Courtney did not like the DVD she bought.

6. Right angles are congruent. $m\angle A = m\angle B$

7. Parallel lines do not intersect. If lines do not intersect, then they have no points in common.

8. If a student attends WAHS, then the student has an ID. Jane has a school ID.

9. If I leave home at 7:00 AM, I can eat breakfast at home. If I drive to school, I can leave home at 7:00 AM.

If I leave home at 7:00 AM, then I can eat breakfast at home.

If I drive to school, I can leave home at 7:00 AM.

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IV Properties of Equality

- A addition if $a = b$, then $a + c = b + c$
 B subtraction if $a = b$, then $a - c = b - c$
 C multiplication if $a = b$, then $ac = bc$
 D division if $a = b$ and $c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$
 E reflexive $a = a$
 F symmetric if $a = b$, then $b = a$
 G transitive if $a = b$ and $b = c$, then $a = c$
 H substitution if $a = b$, then b can replace a
 I distributive $a(b + c) = ab + ac$

*Reflexive, symmetric and transitive are also properties of congruence:

Reflexive: $m < B \cong m < B$

Symmetric: $\overline{AB} \cong \overline{BA}$

Transitive: $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{EF}$ then $\overline{AB} \cong \overline{EF}$

III. Writing a proof

A. given statement: information given about the problem (hypothesis)

B. prove statement: the end result (conclusion)

C. statements: the steps given to get from the given to the prove. (The map of the proof)

D. reasons: why each statement was made. (reasons can be definitions, postulates, theorems, properties of equality)

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Given: $3(x-5) = 10x$

Prove: $x = -\frac{15}{7}$

Statements	Reasons
1) $3(x-5) = 10x$	1)
2) $3x - 15 = 10x$	2)
3) $-15 = 7x$	3)
4) $-\frac{15}{7} = x$	4)
5) $x = -\frac{15}{7}$	5)

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Given:

Prove:

Statements	Reasons

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$$1) \overline{RB} \cong \overline{RB}$$

$$2) \text{ If } \overline{XY} \cong \overline{ZT} \text{ ; } \overline{ZT} \cong \overline{RP}, \text{ then } \overline{XY} \cong \overline{RP}$$

$$3) \text{ If } 3x = 120, \text{ then } x = 40$$

$$4) 12 = AB, \text{ then } AB = 12$$

$$5) \text{ If } y = 75, y = m\angle A, \text{ then } m\angle A = 75$$

$$6) 3x + 4 = 11, 3x = 7$$

$$7) 7(a+x) = 7a + 7x$$

$$8) AY = AY$$

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2.6

V. Proving Angles

A Angle Pairs

1. adjacent angles: 2 coplanar angles with a common vertex and side, but no common interior pts.

2. vertical angles: 2 coplanar nonadjacent angles formed by intersecting lines.

3. complementary angles: 2 angles whose sum is 90° .

4. supplementary angles: 2 angles whose sum is 180° .

5. linear pair: 2 coplanar, adjacent angles that form a line.

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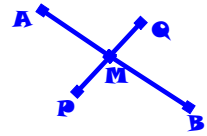
B Lines and segments (review)

1. perpendicular lines
2. segment bisectors
3. angle bisectors

C Theorems: statement proven true.

1. Vertical angles are congruent.
2. If 2 angles are a linear pair, then they're supplementary.
3. All right angles congruent.

Given: $MB = MQ$
 M is midpt of PQ
 Prove: $AB = AM + PM$

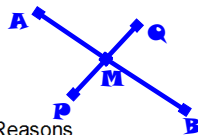


Statements	Reasons
1. $MB = MQ$ M is midpt of PQ	1. given
2. $PM = MQ$	2. def of midpt
3. $MB = PM$	3. transitive prop =
4. $AB = AM + MB$	4. SAP
5. $AB = AM + PM$	5. substitution

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Given: $MB = MQ$
 M is midpt of PQ
 Prove: $MB = \frac{1}{2} PQ$



Statements	Reasons
1. $MB = MQ$ M is midpt of PQ	1. given
2. $PM = MQ$	2. def of midpt
3. $MB = PM$	3. transitive prop =
4. $PQ = PM + MQ$	4. SAP
5. $PQ = MB + MB$	5. substitution
6. $PQ = 2(MB)$	6. simplify
7. $\frac{1}{2} PQ = MB$	7. division
8. $MB = \frac{1}{2} PQ$	8. symmetric prop =

Given: H is the midpt of GR
 Prove: $\frac{1}{2} GR = HR$

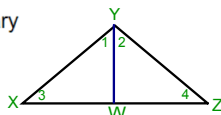


Statements	Reasons

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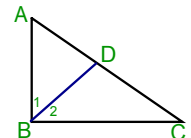
Given: $\angle 3$ and $\angle 4$ are complementary
 $\angle 1 \cong \angle 4$
 $\angle 2 \cong \angle 3$
 Prove: $\overline{XY} \perp \overline{YZ}$



Warm-Up

Statements	Reasons
1. $\angle 3$ and $\angle 4$ are complem $\angle 1 \cong \angle 4$ $\angle 2 \cong \angle 3$	1. _____
2. $m\angle 3 + m\angle 4 = 90$	2. _____
3. $m\angle 2 + m\angle 1 = 90$	3. _____
4. $m\angle XYZ = m\angle 1 + m\angle 2$	4. AAP
5. $m\angle XYZ = 90$	5. <i>substitution</i>
6. $\angle XYZ$ is a right angle	6. <i>def of rt angle</i>
7. $\overline{XY} \perp \overline{YZ}$	7. <i>def of perp</i>

Given: $\angle A$ and $\angle C$ are complementary
 $\angle 1 \cong \angle C$
 $\angle 2 \cong \angle A$
 Prove: $\angle ABC$ is a right angle



Statements	Reasons
1. $\angle A$ and $\angle C$ are complem $\angle 1 \cong \angle C$ $\angle 2 \cong \angle A$	1. given
2. $m\angle A + m\angle C = 90$	2. def of complem
3. $m\angle 2 + m\angle 1 = 90$	3. substitution
4. $m\angle 2 + m\angle 1 = m\angle ABC$	4. AAP
5. $m\angle ABC = 90$	5. substitution
6. $\angle ABC$ is a right angle	6. def of right <

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- D. Bi-conditional: when the conditional and its converse are both true.
1. Written using "if and only if" (*iff*)
 2. Algebraically: $P \leftrightarrow Q$

Ex: Is the statement a bi-conditional? If so, write the bi-conditional.

- 1) If lines are skew, then they are non-coplanar.
Converse:

Bi-conditional:

- 2) If $x = 5$, then $x + 15 = 20$.

- 3) A triangle is a polygon with exactly 3 sides.

- 4) Which statements formed the bi-conditional?
Two angles are congruent iff they have the same measure.

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